FRONTIER MAGNETIC, ELLIPSOMETRIC & TIME-RESOLVED INFRARED SPECTROSCOPY (FIS + MET)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

Frontier Infrared Spectroscopy (FIS) and Magnetic, Ellipsometric and Time-Resolved Infrared Spectroscopy (MET) are beamline programs sharing a large-gap dipole bending radiation source. The design is intended to span the largest possible spectral range as required for materials physics infrared spectroscopy, reaching from microwaves (60 GHz) to the near UV. A primary scientific focus is the behavior of materials under extreme conditions of temperature, pressure, magnetic and photon fields to follow transitions between material phases, including those leading to emergent phenomena.

BEAMLINE CHARACTERISTICS (planned)

TECHNIQUES:

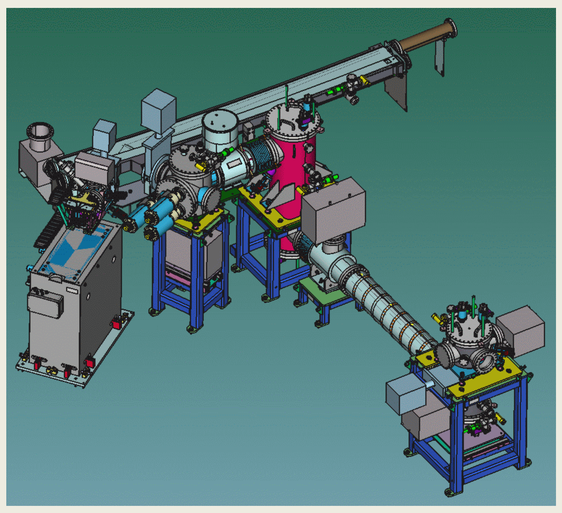
- Infrared and THz Spectroscopies
- Pump-Probe Spectroscopies
- Extreme P, T and B.
- Spectroscopic Ellipsometry

ENDSTATION DETAILS:

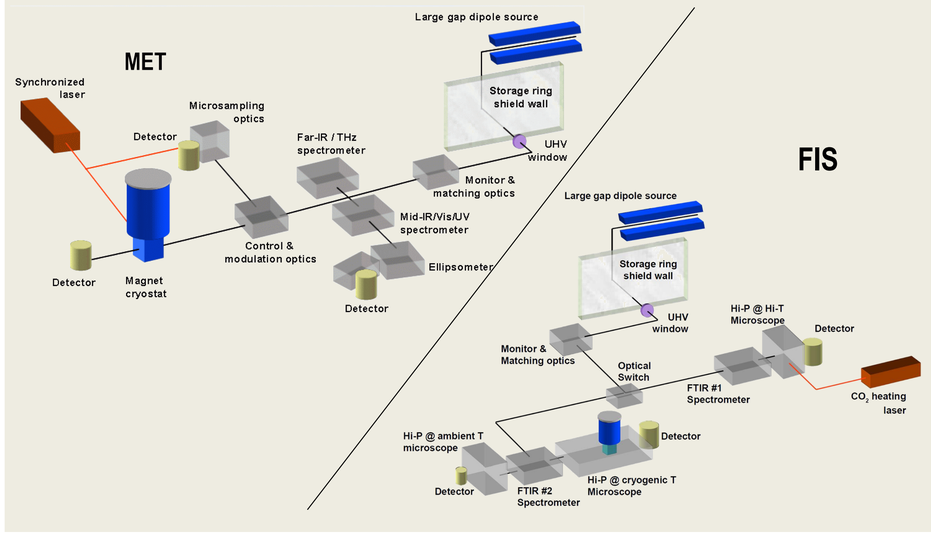
- Müller-Matrix Ellipsometer
- Microscopes & Diamond Anvil Cells
- 10T Magnet and Sample Cryostats
- CO_2 and Ti:sapphire Lasers

FIS+MET at NSLS-II:

- Enables full-range THz, Infrared and Optical spectroscopy for throughput limited measurement methods.
- World leading far-infrared performance, plus ultra-stable beam and environment.
- Endstation tools, including ellipsometry) as needed for studies of emergent behaviors across phase boundaries.
- Time-resolved spectroscopy to 10s of ps.



Infrared and THz Extraction Design (under contract to FMB-Berlin).



Schematic Layout of Dipole Source, Spectrometers and Endstation Instruments

Overview

PORT: 22-IR

SOURCE: Large Gap Dipole Bend

ENERGY RANGE: 250 μeV to >5 eV

ENERGY RESOLUTION: 20 μeV

SPATIAL RESOLUTION: ~λ/NA

BEAMLINE STATUS: Under construction

AVAILABLE TO USERS: Summer 2018

BEAMLINE WEBSITE:

www.bnl.gov/nsls2/beamline/22-IR-1 (FIS)

www.bnl.gov/nsls2/beamline/22-IR-2 (MET)

Beamline Staff

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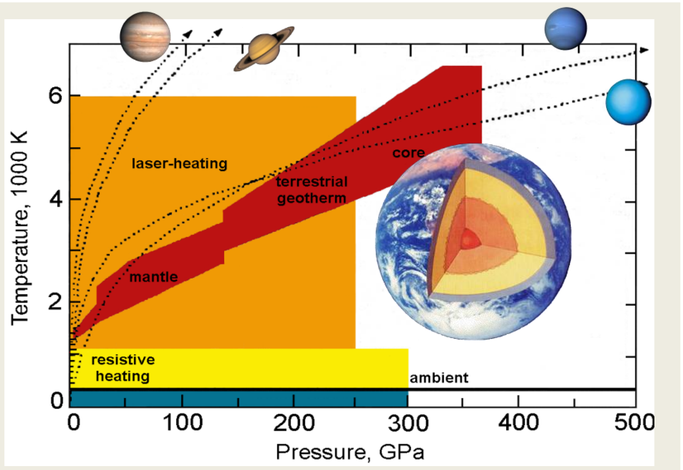
Applying for Beam Time

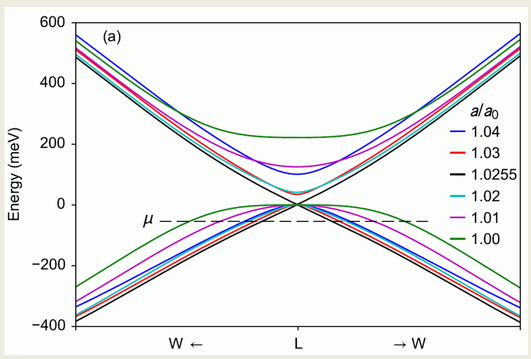
Beamlines at NSLS-II are available to all scientific researchers through a peer-review proposal process. For more information, see the NSLS-II Users' Guide at:

www.bnl.gov/ps/userguide/

SCIENTIFIC APPLICATIONS

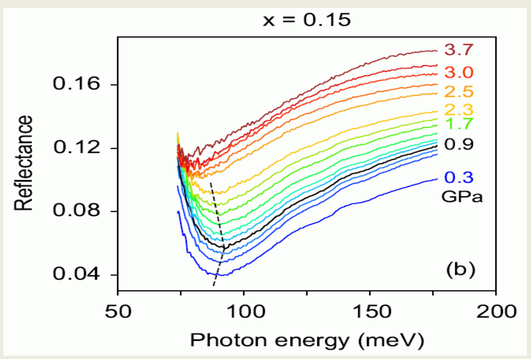


Studies of materials under conditions found at the centers of planets. Examples include induced metallic behavior, unusual crystal structures & associated lattice dynamics, and large quantities of water in the Earth's mantle.



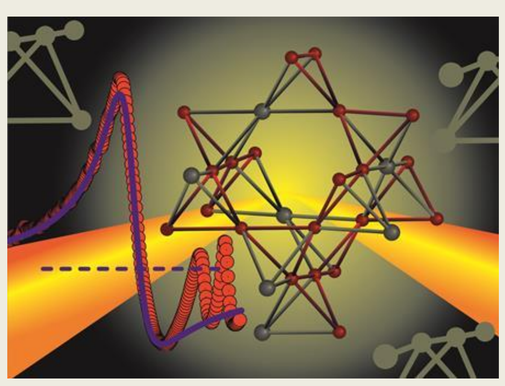
Left: pressure-induced band inversion and topological transition for BiTeI and PbSnTe.

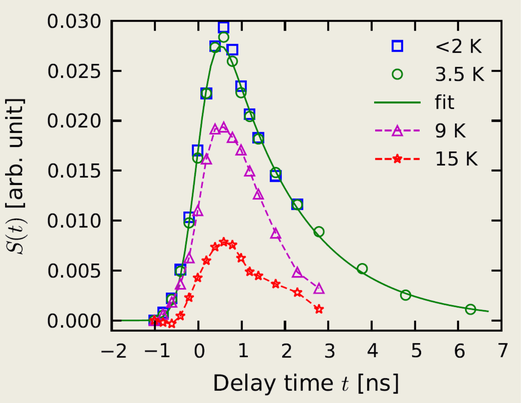
Pressure tuning of electronic properties in topological insulators



Left: IR plasma edge shift due to pressure-induced effective mass changes. *(X. Xi et al, PRL 2013 and 2014)*

Right: Infrared ellipsometric studies of magnetic behavior in spin-frustrated irridates *(A.V. Boris et al)*.





Right: Time-resolved THz spectroscopy of pair relaxation in iron oxy-pnictide superconductor, indicative of a complete (nodeless) energy gap. *(X. Xi et al)*

Superconductivity, multi-ferroics and complex spin systems